Journal of Surgical Oncology 61:239–241 (1996)

GUEST EDITORIAL

Endorectal Ultrasonography

THEODORE J. SACLARIDES, MD
From the Rush Medical College and Rush-Presbyterian-St. Luke's Medical Center, Chicago, Illinois

INTRODUCTION

Endoluminal ultrasonography (ELUS) has become a valuable diagnostic adjunct in the evaluation of patients with prostate, gynecologic, and anorectal malignancies. In contrast to conventional radiographs and computerized tomograms, ELUS has the distinct advantage of being placed in close proximity to the area of concern. As a result, better anatomical resolution and imaging quality can be obtained, and the information is gathered with minimal patient discomfort.

ULTRASOUND PRINCIPLES

Ultrasound transducers contain crystals that emit sound waves when stimulated with an electrical current. As the sound waves enter tissue, they either pass through or are reflected back toward the transducer, which generates an electric impulse, and ultimately an image is produced. The physical properties of tissues differ and the amount of sound that passes through or is reflected may vary considerably. The depth of penetration is also a function of the crystal focal length; higher frequency crystals penetrate less deeply but give better resolution of superficial structures. For example, transabdominal liver scanning is typically performed with 3.5 or 5 megaHertz crystals, whereas imaging the layers of the rectal wall is usually performed with 7.0 or 10.0 megaHertz crystals [1].

INDICATIONS IN MALIGNANT DISEASE

The majority of rectal cancers are usually deeply ulcerating, circumferential, large, or bulky at the time of initial diagnosis. Consequently, radical excision with either a low anterior resection or abdominoperineal resection is required. Occasionally, however, smaller exophytic lesions are encountered, which can be removed by a transanal local excision. Proper patient selection is mandatory if this latter technique is to be used with curative intent without sacrificing local control or patient survival. Hence, the importance of rectal ultrasound. By imaging the layers of the rectal wall, the extent of penetration can be determined, and only those lesions demonstrating minimal penetration are selected for local excision. Following local excision, ultrasound can be used to survey the operative site for any sign of recurrent tumor.

Advocates of preoperative radiation therapy or neoadjuvant chemoradiation point toward the improved local control rates obtained with such therapy. Pretreatment evaluation with rectal ultrasound will identify those lesions most suitable for such therapy and exclude those early, superficial tumors that do not require it. Appropriate lesions include tumors with nodal metastases or those that penetrate the full thickness of the rectal wall either invading the extrarectal fat or neighboring viscera such as the prostate or vagina. Needle biopsies of suspicious lymph nodes under ultrasound guidance can be performed if one wishes to obtain tissue documentation prior to initiating treatment [2].

EQUIPMENT

I perform rectal ultrasound with the Brüel and Kjoer (Naerum, Denmark) Scanner Type 3535 equipped with a hand-held, rotating endoprobe (Type 1850). The probe is 24 cm in length, and either a 7.0 or 10.0 megaHertz crystal is used. The transducers rotate at 4–6 cycles per second and produce a 360° cross-sectional image of the rectum. The end of the probe is covered with a lubricated latex balloon that is filled with water. The water maintains acoustic coupling between the crystal and the tumor against which the balloon is pressed. No air should be allowed within the balloon since this will interfere with sound transmission. For tumors located in the distal rectum or anal canal, the balloon may slip externally. For this reason, I use a nondeformable hard plastic cap instead of the balloon for distal lesions.

Accepted for publication December 20, 1995.

Address reprint requests to Theodore J. Saclarides, M.D., Rush-Presbyterian-St. Luke's Medical Center, 1653 West Congress Parkway, Chicago, IL 60612.

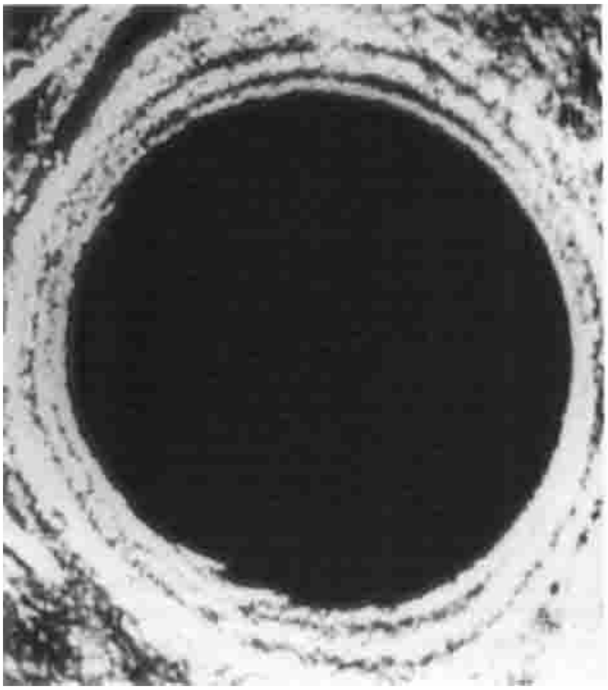

Fig. 1. Sonographic layers of the rectal wall.

Fig. 2. Sonographic stage uT_2 rectal cancer.

TECHNIQUE

Since the endoprobe is of thin caliber, no sedation is required. Either the left lateral or lithotomy position is used. The probe should be placed above the lesion and scanning performed in a proximal to distal direction. Occasionally, one must pass the probe through a specially designed, commercially available proctoscope that is inserted up to the precise location of the lesion. When the tumor is visualized, close-up images are obtained to determine which layers of the rectal wall have been traversed by the tumor.

RESULTS

The sonographic layers of the rectal wall have been determined and are represented by five distinct lines, three hyperechoic and two hypoechoic (Fig. 1). Proceeding outward from the lumen of the rectum they are as follows: 1st hyperechoic line—interface between the balloon and the rectal mucosa; 1st hypoechoic line—mucosa and submucosa; 2nd hyperechoic—interface between the submucosa and the muscularis; 2nd hypoechoic line—muscularis propria; 3rd hyperechoic line—interface between the muscularis and extrarectal fat. Sonographic staging of rectal tumors closely parallels histologic staging with the TNM classification; however, the "u" prefix is added to distinguish between these two staging systems. For example, uT_1 describes a tumor confined to the mucosa and submucosa, uT_2 is a lesion that penetrates the muscularis propria as shown by disruption of the second hyperechoic band (Fig. 2), and uT_3 invades the extrarectal fat, etc.

Local forms of therapy, namely, transanal excision, endocavitary radiation, and fulguration, do not address potential nodal metastases. The risk of nodal disease rises with increasing depth of penetration being ~0–10% for lesions confined to the mucosa and submucosa, 25–30% for lesions that partially penetrate the muscularis, and >50% for lesions which extend to extrarectal fat [3]. Therefore, if the rectal ultrasound shows deep penetration, one may wish to avoid local excision alone as the primary form of treatment.

In the majority of reported series, the sensitivity of rectal ultrasound in determining depth of penetration exceeds 90% [4–6]. Ultrasound is more likely to overestimate than underestimate depth due to peritumor inflammation and edema, which may mimic invasion by the tumor. Pre-operative radiation reduces accuracy to 55%, the depth of penetration in the remaining cases is usually overestimated again due to local fibrosis, inflammation, etc. [7]. Ability to detect metastatic lymph nodes has been less successful and accuracy is contingent on the size and echogenicity of the nodes in question. Metastatic nodes are typically hypoechoic, whereas inflammatory nodes are hyperechoic. Also, accuracy is highest for larger nodes and lowest for nodes smaller than 5 mm.

In comparing the accuracy of ultrasound vs. computed tomography, ultrasound is clearly superior in determining depth of penetration and detecting metastatic lymph nodes [8,9]. Ultrasound's superiority is further supported by its

lower cost, ability to be used in an office examination room, and its mobility, which will permit examinations either in the operating room or at the patient's bedside.

SUMMARY

Endorectal ultrasound has demonstrated its usefulness in selecting which tumors are suitable for local excision and for identifying which lesions might benefit from preoperative chemoradiation. Ultrasound should be part of the armamentarium of any surgeon whose practice has a reasonably high volume of patients with rectal cancer. The only prerequisite in performing this test is that the examiner, whether a radiologist or a surgeon, must have a full appreciation of the consequences of the result. Namely, results of the ultrasound will directly influence the choice of therapy, be it local excision or radical surgery and possibly a colostomy. In my opinion, this distinction is better appreciated by the surgeon; therefore, it is logical and perhaps necessary that rectal ultrasound should become the domain of the surgeon. This is so for several reasons. First, patient care is greatly expedited if, at the time of the initial consultation, ultrasound is performed, thereby obviating the need for patients to return to discuss test results. Second, most surgeons usually perform rigid proctoscopy to determine the distal extent and location of the tumor. Equipped with this information, the surgeon can perform the ultrasound with greater facility and with less discomfort for the patient. Last, patient confidence in his or her surgeon is enhanced if this technical capability is demonstrated by the surgeon and is included in formulating the treatment plan.

REFERENCES

1. Bartram CI, Burnett SJD: Atlas of Anal Endosonography. Oxford: Butterworth-Heinemann, 1991.
2. Milsom JW, Czyrko C, Hull TL, Strong SA, Fazio VW: Preoperative biopsy of pararectal lymph nodes in rectal cancer using endoluminal ultrasonography. Dis Colon Rectum 37:364–368, 1994.
3. Saclarides TJ, Bhattacharyya AK, Britton-Kuzel C, et al.: Predicting Lymph Node Metastases in Rectal Cancer. Dis Colon Rectum 37(1): 52–57, 1994.
4. Herzog U, von Flüe M, Tondelli P, Schuppisser JP: How accurate is endorectal ultrasound in the preoperative staging of rectal cancer? Dis Colon Rectum 36:127–134, 1993.
5. Glaser F, Friedl P, von Ditfurth B, Schlag P, Herfarth C: Influence of endorectal ultrasound on surgical treatment of rectal cancer. Eur J Surg Oncol 16:304–311, 1990.
6. Hulsmans FJ, Tio TL, Fockens P, Bosma A, Tytgat GN: Assessment of tumor infiltration depth in rectal cancer with transrectal sonography: Caution is necessary. Radiology 190:715–720, 1994.
7. Fleshman JW, Myerson RJ, Fry RD, Kodner IJ: Accuracy of transrectal ultrasound in predicting pathologic stage of rectal cancer before and after preoperative radiation therapy. Dis Colon Rectum 35:823–829, 1992.
8. Rifkin MD, Weschler RJ: A comparison of computed tomography and endorectal ultrasound in staging rectal cancer. Int J Colorectal Disease 1:219–233, 1986.
9. Benyon J: An evaluation of the role of rectal endosonography in rectal cancer. Ann R Coll Surg Engl 71:131–139, 1989.